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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER	
POWERS, WILLIAM S	

ART UNIT	PAPER NUMBER
2134	

NOTIFICATION DATE	DELIVERY MODE
01/17/2008	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

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Office Action Summary	Application No. 10/758,457	Applicant(s) YUAN ET AL.	
	Examiner William S. Powers	Art Unit 2134	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 16 January 2004.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-34 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-34 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 16 January 2004 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Information Disclosure Statement

1. The Information Disclosure Statement filed 1/16/2004 has been considered.

Drawings

2. The drawings are objected to because:
 - a. In figure 3a, there is an extraneous reference number "3" by "Alice" that does not reference anything.
 - b. In figure 10a, the reference numbers "203a" and "203b" point to other reference numbers.
 - c. In figure 12, the reference numbers "407" and "411" appear to be pointing to the same line.

Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as "amended." If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes

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made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Specification

3. Applicant is reminded of the proper language and format for an abstract of the disclosure.

The present abstract appears to be nothing more than a copy of claim 1 of the instant application. The abstract should be in narrative form and generally limited to a single paragraph on a separate sheet within the range of 50 to 150 words. It is important that the abstract not exceed 150 words in length since the space provided for the abstract on the computer tape used by the printer is limited. The form and legal phraseology often used in patent claims, such as "means" and "said," should be avoided. The abstract should describe the disclosure sufficiently to assist readers in deciding whether there is a need for consulting the full patent text for details.

The language should be clear and concise and should not repeat information given in the title. It should avoid using phrases which can be implied, such as, "The

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disclosure concerns," "The disclosure defined by this invention," "The disclosure describes," etc.

Claim Objections

4. Claims 6, 18, 25, 26, 33 and 34 are objected to because of the following informalities:

- a. As to claim 6, the limitations "a clock pulse" in line 1 and "each group of photons" in line 2, lack antecedent basis.
- b. As to claim 18, the limitation "the phase encoding means" in line 1 lacks antecedent basis.
- c. As to claim 25, the limitations "the interferometers" in line 2 and "the second interferometer" in lines 3-4, lack antecedent basis.
- d. As to claim 26, the limitation "the third or fourth interferometers" in lines 3-4 lacks antecedent basis.
- e. As to claims 33 and 34, the limitation "the emitted pulses" in line 5 of each claim lacks antecedent basis.

Appropriate correction is required.

Claim Rejections - 35 USC § 112

5. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

6. Claims 1, 4, 12-14, 17, 21, 24, 33 and 34 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

As to claims 1, 33 and 34, the term "each photon pulse having a probability of containing at most one photon" present in each of the claims is a relative term which renders the claim indefinite. The term "having a probability" is not defined by the claim, the specification does not provide a standard for ascertaining the requisite degree, and one of ordinary skill in the art would not be reasonably apprised of the scope of the invention. The aforementioned limitation does not require that each photon pulse contains at most one photon, but only there is a **probability** that each photon pulse contains at most one photon. There is also a probability that each photon pulse contains more than one photon.

As to claim 12, it is unclear from the claim language and the specification how phase is used to encode the photon pulses. The specification indicates that manipulation of the phase (e.g., phase shift or phase modulation) of the photon is used in encoding the photon. For purposes of examination, the Examiner interprets "using

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phase" as manipulating the phase of the photon in order to encode information in the photon.

As to claim 4, it is not clear if the limitation "signals" in the claims refers to photon pulses or individual photon pulse or to groups of photon pulses of claim 1 or is something altogether different.

As to claims 13, 14, 17, 21 and 24, the claims have limitations that use the word "allow". It is pointed out that the word "allow" does not make the limitations associated with it positive recitations and, as such, introduces indefiniteness to the claims. The photons can have different polarizations or different values as they pass through different arms of the interferometers, but the limitation "allow" does not require them to have different polarizations or different values as they pass through different arms of the interferometers.

Claim Rejections - 35 USC § 102

2. The Examiner has stated the below column and line numbers as examples. All columns and line numbers in the reference and the figures are relevant material and Applicant should be taken the entire reference into consideration upon the reply to this Office Action.

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

4. Claims 1, 2, 5-12 and 32-34 are rejected under 35 U.S.C. 102(b) as being anticipated by US Patent No. 5,764,765 to Phoenix et al. (hereinafter Phoenix).

As to claims 1, 33 and 34 as best understood, Phoenix teaches:

- a. An emitter configured to emit a plurality of photon pulses in groups of photon pulses, each group of photon pulses emitted over a group time period, each photon pulse having a probability of containing at most one photon (source for single-photon signals) (Phoenix, column 3, lines 10-12).
- b. A detector comprising gating means configured to switch the detector between an on state and an off state (a gate controls the admittance of photons to the detector) (Phoenix, column 4, lines 1-6).
- c. The detector is in an on state for at least the duration of two photon pulses during said group time period (single photon detector receives many pulses for each timing pulse) (Phoenix, column 4, lines 57-65).

As to claim 2, Phoenix teaches the detector is in an on state for the whole of a said group time period (single photon detector receives many pulses for each timing pulse) (Phoenix, column 4, lines 57-65).

As to claim 5, Phoenix teaches means to communicate a clock signal between the emitter and detector (timing/calibration signal is sent in separate or concurrently with key data) (Phoenix, column 4, lines 47-51).

As to claim 6, Phoenix teaches a clock pulse is sent from the emitter to the detector with each group of photons (timing/calibration signal is sent in separate or concurrently with key data) (Phoenix, column 4, lines 47-51).

As to claim 7, Phoenix teaches the clock signal has a different wavelength to that of the photon pulses (separate wavelength for timing pulse) (Phoenix, column 4, lines 47-51).

As to claim 8, Phoenix teaches the clock signal has a different polarization to that of the photon pulses (signals go through polarization modules) (Phoenix, column 4, lines 13-20).

As to claim 9, Phoenix teaches the detector is an avalanche photodiode (Phoenix, column 4, lines 29-46).

As to claim 10, Phoenix teaches the photons which are sent to the detector are encoded (encoding single photons) (Phoenix, column 6, lines 31-33).

As to claim 11, Phoenix teaches each photon pulse in a group of photon pulses is encoded independently of the other pulses in the group of photon pulses (encoding single photons) (Phoenix, column 6, lines 31-33).

As to claim 12 as best understood, Phoenix teaches the photon pulses are encoded using phase (the use of phase modulation in the encoding process) (Phoenix, column 6, lines 31-50).

As to claim 32, Phoenix teaches said emitter comprises a photon source, means to subdivide the output of said source into a plurality of optical fibers having differing lengths and combiner means to combine said plurality of fibers such that a plurality of pulses spaced apart in time are outputted from said combiner means (the quantum cryptographic network used by Phoenix is an optical network) (Phoenix, column 3, lines 53-65).

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

6. The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

7. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

8. Claim 3 is rejected under 35 U.S.C. 103(a) as being unpatentable over US Patent No. 5,764,765 to Phoenix et al. (hereinafter Phoenix) as applied to claim 1 above, and further in view of US Patent No. 5,757,912 to Blow.

As to claim 3, Phoenix does not expressly mention turning on and off the detector. However, in an analogous art, Blow teaches the detector is repetitively switched on and off during said group time period, so as to be on during the arrival of the photon pulses (using switchable attenuators and time-division multiplexing to isolate photon pulses) (Blow, column 8, lines 27-59).

Therefore, one of ordinary skill in at the time the invention was made would have been motivated to implement the quantum communication scheme of Phoenix with the detector switches of Blow in order to "operate quantum and data channels at the same wavelength" as suggested by Blow (Blow, column 8, lines 27-29).

9. Claim 4 and claims 13-27 are rejected under 35 U.S.C. 103(a) as being unpatentable over US Patent No. 5,764,765 to Phoenix et al. (hereinafter Phoenix) as applied to claim 1 and claim 12 respectively above, and further in view of US Patent No. 5,307,410 to Bennett.

As to claim 4 as best understood, Phoenix does not mention ignoring signals. However, in an analogous art, Bennett teaches means to ignore any second or subsequent signals received by the detector in a given group time period after a first

signal has been received (undelayed pulses are discarded in favor of once-delayed pulses) (Bennett, column 7, lines 14-36).

Therefore, one of ordinary skill in the art at the time the invention was made would have been motivated to implement the quantum communication scheme of Phoenix with the selective discarded of undesirable pulses of Bennett in order to protect the key transmission from being intercepted and used by eavesdroppers as suggested by Bennett (Bennett, column 1, lines 5-10).

As to claim 13, Phoenix as modified teaches a first interferometer having a long arm and a short arm, one of said arms having phase variation means which allows the phase of a photon passing through that arm to be set to one of at least two values (interferometers that consist of long and short paths (arms) and depending on the paths traveled by the photon, different values are assigned to the photon) (Bennett, column 7, lines 1-36).

As to claim 14, Phoenix as modified teaches a second interferometer having a long arm and a short arm, one of said arms having phase variation means which allows the phase of a photon passing through that arm to be set to one of at least two values (interferometers that consist of long and short paths (arms) and depending on the paths traveled by the photon, different values are assigned to the photon) (Bennett, column 7, lines 1-36).

As to claim 15, Phoenix as modified teaches the detector being further configured to ignore signals from photon pulses which pass through the long arms of both interferometers or the short arms of both interferometers (signals that travel both short paths are discarded and signals that travel both long paths have no phase information and are used only to detect eavesdropping) (Bennett, column 7, lines 1-56).

As to claim 16, Phoenix as modified teaches directing means to ensure that photons which have passed through the short arm of the first interferometer are directed down the long arm of the second interferometer and photons which have passed through the long arm of the first interferometer pass through the short arm of the second interferometer (the once delayed pulse travels short then long and long then short) (Bennett, column 7, lines 1-13).

As to claim 17, Phoenix as modified teaches the directing means comprises first polarizing means configured to allow photons which have traveled through different arms of the first interferometer different polarisations and second polarizing means which distinguish between the photons having different polarizations and direct them down the appropriate arm of the second interferometer (the interferometers could use polarization in detection of photons). (Bennett, column 9, lines 16-30).

As to claims 18-24 and 26, Phoenix as modified discloses the claimed invention except for the additional interferometers at the sending and receiving ends. It would

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have been obvious to one having ordinary skill in the art at the time the invention was made to add another interferometer at the sending and receiving ends, since it has been held that mere duplication of the essential working parts of a device involves only routine skill in the art. *St. Regis Paper Co. v. Bemis Co.*, 193 USPQ 8.

As to claim 18, claim 18 is essentially the same as claim 13, except for the differences mentioned above and is similarly rejected.

As to claim 19, claim 19 is essentially the same as claim 14, except for the differences mentioned above and is similarly rejected.

As to claim 20, claim 20 is essentially the same as claim 15, except for the differences mentioned above and is similarly rejected.

As to claim 21, Phoenix as modified teaches the phase encoding means comprises a first station comprising first interferometer having a long arm and a short arm, one of said arms having a phase variation means which allows the phase of a photon passing through that arm to be set to one of at least two values, a second station comprising means to apply a phase variation which allows a photon pulse passing therethrough to have its phase set to one of at least two values (interferometers that consist of long and short paths (arms) and depending on the paths traveled by the photon, different values are assigned to the photon) (Bennett, column 7, lines 1-36) and

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reflecting means to reflect the pulse back through the first interferometer (mirrors reflect the pulse beams) (Bennett, column 6, lines 47-67).

As to claim 22, Phoenix as modified teaches the detector is configured to ignore photon pulses which have passed through either the long arm of the first interferometer twice or the short arm of the first interferometer twice (signals that travel both short paths are discarded and signals that travel both long paths have no phase information and are used only to detect eavesdropping) (Bennett, column 7, lines 1-56).

As to claim 23, Phoenix as modified teaches directing means configured to ensure that photons which have passed through the short arm of the first interferometer are reflected back through the long arm of the first interferometer and photons which have passed through the long arm of the first interferometer are reflected back through the short arm of the first interferometer (mirrors reflect the pulse beams) (Bennett, column 6, lines 47-67).

As to claim 24, the claim is essentially the same as claim 17, except for the differences mentioned above, and is similarly rejected.

As to claim 25, Phoenix as modified teaches means to vary the path length of one of the arms of at least one of the interferometers such that photon pulses which take the short arm of one of the first interferometer and the long arm of the second

interferometer take the same time to pass through both interferometers as photon pulses which pass through the long arm of the first interferometer and the short arm of the second interferometer (the pulses that travel the long-short path and the short-long path arrive at the same time) (Bennett, column 7, lines 1-56).

As to claim 26, the claim is essentially the same as claim 25, except for the differences mentioned above, and is similarly rejected.

As to claim 27, Phoenix as modified teaches the photons are encoded using polarization (encoding using polarization) (Bennett, column 2, lines 20-38).

10. Claims 28-31 are rejected under 35 U.S.C. 103(a) as being unpatentable over US Patent No. 5,764,765 to Phoenix et al. (hereinafter Phoenix).

As to claims 28-31, Official Notice is taken that it would have been obvious to one of ordinary skill in the art to vary the number of pulses in each group, the number of photons per pulse and use a range of timing intervals to improve the efficiency and the reduce the occurrence of pulse collisions in the operation of the invention.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to William S. Powers whose telephone number is 751 272 8573. The examiner can normally be reached on m-f 7:30-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kambiz Zand can be reached on 571 272 3811. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.



1/7/2008

William S. Powers
Examiner
Art Unit 2134



KAMBIZ ZAND
SUPERVISORY PATENT EXAMINER